

WHAT IS CLAIMED IS

5 1. A light control element comprising:
 a substrate;
 an optical coupling component formed on
said substrate by a photonic crystal structure; and
 a variable refractive index part provided
10 in a part of said photonic crystal structure so as to
divide said optical coupling component into two
regions,

 wherein a traveling direction of a light is
changed at an interface of said regions by changing a
15 refractive index at said variable refractive index
part such that there is caused reflection for at
least one wavenumber of said light.

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 2. A light control element comprising:
 a substrate;
 an optical waveguide formed on said
25 substrate;

an optical coupling component provided on said substrate by a photonic crystal structure, said optical waveguides being connected to said optical coupling component; and

5 a variable refractive index part provided in a part of said photonic crystal structure, said variable refractive index part dividing said optical coupling component into at least two regions,

wherein an interface between said regions
10 changes a traveling direction of a light incident thereto by causing reflection in at least one wavenumber of said light in response to a change of refractive index in said variable refractive index part.

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3. A light control element comprising:

20 a substrate;

a plurality of optical waveguides formed on said substrate;

25 an optical coupling component formed on said substrate, at least three of said optical waveguides being coupled to said optical coupling

component; and

a photonic crystal formed on at least one of said optical waveguides at an end part thereof coupled to said optical coupling component,

5 said light control element changing a transmittance of light through said optical waveguide in a part corresponding to said photonic crystal structure in response to a change of refractive index of said photonic crystal structure.

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4. A light control element comprising:

15 a substrate;

a plurality of optical waveguides formed on said substrate;

20 an optical coupling component formed of a photonic crystal and provided on said substrate in a polygonal form, at least four of said optical waveguides being coupled to said optical coupling component; and

25 a plurality of variable refractive index parts formed in said polygonal optical coupling component, said plurality of variable refractive

index parts being formed in one or more regions of said polygonal optical coupling component divided from each other by a diagonal line,

5 said plurality of variable refractive index parts changing a refractive index thereof independently,

10 said light control element deflecting a traveling direction of light in said optical waveguide in response to a change of refractive index 10 of said variable refractive index part.

15 5. A light control element comprising:

 a substrate;

 a plurality of optical waveguides formed on said substrates;

20 an optical coupling component formed of a photonic crystal and provided on said substrate in a polygonal form, at least four of said optical waveguides being connected to said optical coupling component;

25 a photonic crystal formed on said optical waveguides at an end part thereof connected to said

optical coupling component; and

a plurality of variable refractive index parts formed of said photonic crystal and provided on said optical waveguide in correspondence to regions of said polygonal optical coupling component divided from each other by a diagonal line,

said variable refractive index parts changing a refractive index thereof independently,

10 said light control element deflecting a traveling direction of light from said optical waveguide in response to a change of refractive index of said variable refractive index part.

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6. A light control element comprising:

a substrate;

20 a plurality of optical waveguides formed on said substrate; and

an optical coupling component formed of a photonic crystal and provided on said substrate in a polygonal form, at least four of said optical waveguides being coupled to said polygonal optical 25 coupling component; and

a plurality of variable refractive index parts formed in respective regions of said polygonal optical coupling components, said regions being divided from each other by a diagonal line of said 5 polygonal optical coupling component,
said variable refractive index parts changing a refractive index thereof independently,
said light control element branching a light in said optical waveguide in response to a 10 change of refractive index of said variable refractive index part.

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7. A light control element comprising:
a substrate;
a plurality of optical waveguides formed on said substrate;
20 an optical coupling component formed on said substrate and coupled with at least three of said optical waveguides;
first and second photonic crystals formed on an optical waveguide coupled to said optical 25 coupling component at an end part thereof coupled to

5 said optical coupling component, said first photonic crystal including a structure for reflecting or transmitting a transverse electric mode wave, said second photonic crystal including a structure for reflecting or transmitting a transverse magnetic mode wave; and

10 first and second variable refractive index parts provided respectively by said first and second photonic crystals, said first variable refractive index part and said second variable refractive index part respectively changing a transmittance of said transverse electric mode wave and a transmittance of said transverse magnetic mode wave independently from each other,

15 said light control element separating a transverse electric mode wave and a transverse magnetic mode wave in response to a change of refractive index of said first and second variable refractive index parts.

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25 8. A light control element, comprising:
a substrate;

a plurality of optical waveguides formed on said substrate;

an optical coupling component formed on said substrate, at least three of said optical 5 waveguides being connected to said optical coupling element;

first and second photonic crystals formed on an optical waveguide coupled to said optical coupling component at an end part thereof coupled to 10 said optical coupling component, said first and second photonic crystals respectively including a structure for reflecting or transmitting a transverse electric mode wave and a structure for reflecting or transmitting a transverse magnetic mode 15 wave; and

first and second variable refractive index parts formed respectively in said first and second photonic crystals, said first variable refractive index part and said second variable refractive index 20 part changing a transmittance of said transverse electric mode wave and a transmittance of said transverse magnetic mode wave respectively by changing a refractive index of said first and second variable refractive index parts independently.

9. A light control element as claimed in
claim 1, wherein said photonic crystal includes a
defect region.

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10. A light control element as claimed in
claim 9, wherein said photonic crystal includes at
10 least two layers of photonic crystal arrays at both
sides of said defect region, a refractive index being
changed for said defect region.

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11. A light control element as claimed in
claim 9, wherein said photonic crystal includes at
least two layers of photonic crystal arrays at both
20 sides of said defect region, a refractive index being
changed for the entirety of said photonic crystal.

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12. A light control element as claimed in
claim 9, wherein said photonic crystal includes at
least two layers of photonic crystal arrays at both
sides of said defect region, each of said photonic
5 crystal arrays including the same number of layers.

10 13. A light control element as claimed in
claim 12, wherein the number of layers of the
photonic crystal array is ten or less.

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14. A light control element as claimed in
claim 9, wherein said photonic crystal has a
structure having a wave vector component of a light
20 incident to said defect region through said photonic
crystal in a direction other than the direction
perpendicular to the elongating direction of the
defect region.

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15. A light control element as claimed in
claim 9, wherein the photonic crystal includes plural
defect regions of different sizes.

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16. A light control element comprising:
a substrate having a photonic crystal
10 structure;
a plurality of optical waveguides formed in
said photonic crystal structure in the form of a line
defect of said photonic crystal structure; and
a variable refractive index part formed in
15 an optical coupling part in which said optical
waveguides intersect with each other,
said light control element controlling a
state of resonance in said optical coupling part by
changing a refractive index of said refractive index
20 variable part.

25 17. A light control element comprising:

a substrate having a photonic crystal structure;

a plurality of optical waveguides formed in said photonic crystal structure of said substrate in 5 the form of a line defect of said photonic crystal structure; and

variable refractive index parts set to respective parts of said photonic crystal structure defined by said optical waveguides,

10 said light control element changing a refractive index of said variable refractive index parts independently.

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18. light control device, comprising:

a substrate;

NxN optical waveguides formed on said 20 substrate so as to cross with each other at intersections distributed two-dimensionally on said substrate; and

N^2 optical coupling components each provided to one of said intersections of said optical 25 waveguides,

a variable refractive index part provided to each of said optical coupling component,

each of said variable refractive index part forming a light control element of any of the first 5 through fourteenth aspect of the present invention.

10 19. A light control device comprising:

a substrate having a photonic crystal structure;

15 NxNxN optical waveguides formed in said photonic crystal structure of said substrate so as to cross with each other at intersections distributed two dimensionally on said substrate and

an optical coupling part formed in each of said intersections,

20 said optical coupling part including a photonic crystal forming a variable refractive index part.